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To determine the effectiveness of group articulation therapy, 180 educable retarded children in special classes (average age 9, average IQ 70), all of whom had articulation problems, were rated on the Carter/Buck Prognostic Speech Test and a picture version of McDonald's deep test of articulation. Subjects were then randomly assigned to one of three groups: no therapy, therapy for 30 minutes once a week for 9 months, or therapy for 30 minutes four times weekly for 9 months. Posttests were administered immediately after 9 months and again 3 months later. Results on picture deep test indicated that subjects who received therapy four times weekly improved significantly, whereas subjects who had therapy once a week did not. On the picture articulation test, however, no significant differences were found between experimental groups. At the time of the second posttesting, the picture articulation improvements by the subjects who had therapy four times weekly were maintained as were the respective positions of subjects in the three groups. Significant relationships were also found between mental age and IQ and articulation improvement during therapy. (JD) [Not available in hardcopy due to marginal legibility of original document]

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Ronald K. Sommers, Ed.D.
Montgomery County Schools
Norristown, Pennsylvania 19404

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SUMMARY

The principal hypothesis investigated in this project concerned the degree to which educable retarded children would benefit from group articulation therapy. It was hypothesized that subjects who received group articulation therapy for four periods per week would achieve significant improvements compared with a group that received therapy one time per week and control group subjects. It was further suggested that groups of subjects who received group articulation therapy for one period each week would not be significantly improved compared with control group subjects. Finally, it was suggested that the effectiveness of articulation therapy for educable retarded children was dependent upon their stimulability performances and their total degree of articulatory defectiveness.

The 180 subjects in this study were drawn randomly from a population of 353 educable retarded children enrolled in 42 special classes within Montgomery County, Pennsylvania, schools and determined to have problems in articulation. Subjects were examined by trained raters on two articulation tasks. The first of these was a modified version of the Carter/Buck Prognostic Speech Test. The second was a picture version of McDonald's deep test of articulation. Based upon their performances, groups of subjects were selected who had "poor" and "good" prognostic scores and "moderate" and "severe" degrees of articulatory defectiveness. Using random procedures, subjects performing at different levels on each of the two articulatory tasks were randomly assigned to either:

a) a control group which received no speech therapy for a period of 15 months,

b) an experimental group which received one period of group articulation therapy weekly during a nine month school year, and

c) an experimental group which received four periods weekly of group articulation therapy during a school year.

As a result of these activities, 12 cells of 15 subjects each were entered into a factorial design.

Dependent variables were administered three times during the course of the experiment. All subjects were tested at the beginning and end of the nine month treatment period on a version of McDonald's picture articulation test. Difference scores were computed for each subject for each of the defective phonemes (21 phonemes were studied in this project). At the end of the experimental period (the Post I time), an additional secondary dependent variable, namely, a modified version of McDonald's sentence deep test, was administered. Subjects' performances were determined on the basis of number of errors on this task. Three months after the end of the experimental period, all subjects were re-examined on each of the two instruments. In the interim, none of the 180 subjects received any articulation therapy.

The group articulation therapy was administered to the 60 subjects who received it once weekly and the 60 subjects who received it four times weekly during a regular school year. The group articulation therapy sessions were 30 minutes in length. Subjects who received therapy four times a week contrasted with those who received it once a week in effect received three and a half times more therapy during the course of the experiment. Articulation therapy was administered by four speech clinicians, two of whom were well experienced and of demonstrated capabilities, and two of whom were new members of the speech and hearing profession.

The results of the study indicated that subjects who received group articulation therapy four times per week during the experimental period were significantly improved in articulation as measured on a picture deep test, compared with control group subjects. Subjects who received group articulation therapy once weekly during the experimental period were not significantly improved compared with control group subjects. The trend was for more therapy to result in greater improvement in articulation. The type of articulation deemed to be improved consisted of the production of formally misarticulated phonemes elicited in a single-word form, i.e., this type of articulation consisted of measurements across individualized units of speech, such as words. On the secondary dependent variable, namely, the picture articulation test, no significant differences were found between experimental groups. At the time of the Post II testing, the picture articulation improvements manifested by the subjects who received therapy four times weekly were maintained as were the respective positions of subjects in the three groups. The main effect of therapy was significant on the primary dependent variable; however, hypothesized relationships to total severity of articulatory defectiveness and prognostic speech scores were not obtained. Therefore, the results supported the assertion that educable retarded children are capable of making significant improvements in the acquisition of articulation skills. The results do not support the prognostic importance of stimulability testing, as measured on the Carter/Buck test, and defied the importance of total degree of articulatory defectiveness in prediction of change. No interactions were found between these two variables and the main therapy effect.

A series of analyses were performed relating variables of mental age, chronological age, IQ and socioeconomic class to initial degree of articulatory defectiveness and improvements during the experimental period. Many of the variables were not related; however, slight and statistically significant relationships were found between mental age and IQ and improvement during the experimental period. Of importance was the fact that after the termination of therapy for all subjects, no further changes were found in the articulatory proficiency of any of the subjects in this project. The conclusion is that articulation development in educable retarded children has a great deal of uniqueness, appears intractable without a substantial amount of therapy intervention, and that such children do not make improvements in articulation after therapy has been discontinued.

INTRODUCTION

A large percentage of identified educable mentally retarded children are enrolled in special classes within the public schools; many others remain in regular classes. Typically such children have not been recipients of certain special services such as speech correction. Speech correctional services in public schools, not uncommonly in great demand, have often not been provided for educable retarded children for a number of reasons. One of these may stem from the rather gloomy forecasts of certain authorities in speech correction who have maintained that retarded children may not benefit from such services (West, Kennedy, and Carr, 1946; Immel, 1938). With the large caseloads encountered by speech clinicians in school settings, the recurrent demands for additional services for children of normal ability, and skepticism about the efficacy of such endeavors, opportunities have been lacking for speech correctional services for retarded children.

Surveys of the prevalence of speech defects in retarded children have been conducted rather extensively in institutionalized populations (Liebman, 1955; Mecham, 1955; Schlanger & Gottsleben, 1957; Sirkin & Lyons, 1941) and to a limited degree in schools (Schiefelbusch, 1963; Wilson, 1966). The reported prevalence of speech defects in children enrolled in special classes in the public schools varies from eight to twenty-six percent (Spraldin, 1963) to 53.41% determined by Wilson (1966). In contrast to the typical figures cited for the prevalence of speech defects in public school children with normal intelligence, that is, five percent (White House Conference, 1950), it would appear that educable retarded children have consistently been identified as having significantly higher degrees of speech defectiveness compared with school children of normal intelligence.

The efficacy of speech correctional procedures with the retarded has not enjoyed wide investigation. A number of studies based upon institutionalized subjects, many of whom were described by the authors as having a heterogeneity of speech disorders and concomitant problems such as emotional disturbances, have suggested that speech correctional procedures may have efficacy if applied under certain conditions. However, some of these studies have been limited in the number of subjects studied (Schneider & Vallon, 1955), the types of subjects studied (Sirkin & Lyons, 1941), and show weaknesses in research design, such as lack of control group subjects (Schlanger, 1953).

The effectiveness of speech correctional procedures for educable retarded children in school classes having articulatory problems has virtually not been determined. One recent study, that by Wilson (1966), is the sole study existing in the literature which investigated the hypothesis that articulatory defective, educable retarded children will make significant benefits as a result of articulation therapy. Wilson's findings, based on a three-year study of educable retarded children from public school classes in suburban St. Louis, Missouri, casts serious doubts upon the efficacy of providing group articulation therapy for two 30-minute periods weekly to a population of such children. Although the trend of the means of Wilson's study was in favor of the experimental-group subjects, the differences were not significant, and Wilson concluded that the application of direct articulation therapy did not significantly alter the number of error sounds produced by the children in the experimental group.

Because of important differences in the results of the present study compared with those of Wilson, (1966), it seemed advisable to present some relevant details of Wilson's study for purposes of comparison with those of this project. (These are contained in the conclusion section of this document). The nature of the retarded population and other factors such as socioeconomics are worthy of description since some aspects of the two projects appeared comparable.

Similarities between the socioeconomic conditions and school services provided in the Special School District of St. Louis, where Wilson did his research, and those in Montgomery County, Pennsylvania, where the present study was conducted were of interest. Both Special School Districts are located adjacent to large cities, viz., St. Louis, Missouri, and Philadelphia, Pennsylvania, respectively. Both have well-developed Special Education programs of long-standing. Both have staffs of thirty or more speech clinicians employed on their programs. The socioeconomic levels of the suburban counties where these studies were conducted were also very comparable. For example, in Montgomery County, Pennsylvania, the typical socioeconomic level was formally determined to be 23% higher than that expected from the nation as a whole (Sommers, 1962). A similar socioeconomic level appeared to exist in the school district of St. Louis.[1] In summary, comparisons of the results of the study by Wilson and those by the author of this project seemed to be comparable in the sense that children with the same range of mental abilities (IQ's 50 - 75) were assigned to special classes on the basis of psychologists' examinations using similar testing instruments (primarily, the Stanford-Binet Intelligence Scale); services of all types for exceptional children, such as psychological, speech correction, classes for deaf, blind, partially sighted, schools for physcially handicapped, and so forth, were offered on a similar basis throughout the areas; the areas were both located adjacent to large cities, were rapidly developing, and intensive in-service education was frequently provided to professional personnel.

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[1] These assertions stem from two visitations and inspections of the Special School District by the author during the past four years.

Comparisons with Other Research

The present project was designed to test the findings of a study completed by the authors and published in the Journal of Speech and Hearing Disorders in 1967. This study determined the efficacy of group articulation therapy for kindergarten, first grade, and second grade school children within the public schools of Montgomery County, Pennsylvania. The design of the study, the therapy procedures, and the data analysis were similar to those of the present project. In effect, the author attempted a virtual replication of a study done on kindergarten, first grade, and second grade children with articulatory problems having normal intelligence, and did so with a population of educable-retarded children from the same school-area. The results of the 1967 study indicated that the stimulability performances of the children were related to the degree to which they benefited from group articulation therapy, and those children having "poor" stimulability (as measured on a version of the Carter-Buck Prognostic Speech Test), achieved significantly greater improvements as a result of these experiences than did those subjects with "good" stimulability scores. It was additionally established that all subjects, regardless of stimulability performances, improved significantly on a picture version of McDonald's Deep Test of Articulation compared with controls during a one-school-year period of speech therapy. Also, that the amount of improvement resulting from group articulation therapy was independent of the subjects' grade levels. Finally, that the amount of change in articulation was greatest for subjects having more severe degrees of articulatory defectiveness contrasted with those having less severe problems.

The design of the 1967 study was a four-factor, factorial one involving 252 subjects randomly assigned to either therapy once weekly or no therapy during the course of the nine-months' school year. Articulation therapy was provided by a staff of 20 speech clinicians following rather traditional speech therapy methods, not unlike those described as utilized in the present study (See pp. 21-23).

The present study, based as it was upon prior research showing that speech therapy was effective for children drawn from regular classes in kindergarten, first, and second grades, was intended to investigate similar hypotheses in a population of educable-retarded children. The authors were particularly interested in determining whether the findings, based on articulatory defectiveness in children having normal intelligence, would obtain for educable retarded children from the same regional area. The degree to which stimulability would become predictive in allowing speech clinicians in school systems to select educable-retarded children for therapy was of particular importance, in view of Wilson's negative findings and the present investigator's belief that case selection factors might be as important or more important in predicting success in speech correction for educable retarded children. Additionally, a variable not investigated in the 1967 study, was the extent to which both the amount and intensity of articulation therapy would relate to changes and improvements. This variable was entered into the experimental design of the present project. The principal reason for introducing it was Wilson's negative finding that two 30-minute periods of group therapy was ineffective in improving articulation. It was the author's feeling that significant improvements in articulation might well relate to increasing the amount of therapy and its intensity on a weekly basis. Therefore, this independent variable assumed a major importance in the project and was introduced as a level in the factorial design. The severity finding of the 1967 study, previously supported in the work of a number of researchers in articulation who studied children having normal abilities (Sommers, 1967) and most recently by Wilson in his study of educable retarded children (1966), was also included as an independent variable in order to assess its effect upon the outcome of therapy and, further, to determine whether retarded subjects more severely defective in articulation would evidence greater changes towards improvement than would children having lesser degrees of difficulty.

Finally, an additional purpose in the present project was to take reasonably well-defined, accepted, and traditional articulation methods (outlined by Van Riper, 1963; Berry and Eisenson, 1956), seemingly similar to those described by Wilson (1966), and apply these to the educable-retarded children without drastic modification. It seemed likely that these rather traditional methods, demonstrated to have efficacy with kindergarten, first grade and second grade school children (Sommers et al, 1967) might be efficacious with educable retarded children. Said differently, the present project was not designed to investigate the efficacy of radically different or totally unique articulation therapy procedures and methodologies; rather, it was designed to test those commonly used with articulatory defective children having normal abilities to determine whether such standard procedures might have efficacy with retarded children. This "basic test" appeared required in view of the limited research findings to date and the rather large body of positive findings demonstrating that the articulation of children having normal abilities could be modified positively with procedures of this type.

Therefore, the present study was designed to:

A. Investigate the efficacy of group articulation therapy for educable mentally retarded children.

B. Determine the effectiveness of articulation therapy and relate this to other variables of possible importance, namely, the frequency of the speech therapy provided, the severity of articulatory defectiveness, and the stimulability performances of the subjects.

Hypotheses Under Investigation

A. Using deep test articulation scores as the primary dependent variable, the following hypotheses were tested:

(1) Subjects who received group articulation therapy for four periods per week during the nine months experimental period achieved significant improvements compared with a group who received therapy one-time each week and control group subjects.

(2) The group of subjects who received group articulation therapy for one period each week during the nine-months experimental period were not significantly improved compared with control group subjects.

(3) The effectiveness of articulation therapy was dependent upon the stimulability performances of the subjects, and those having "poor" stimulability scores would benefit significantly from speech therapy contrasted with those having "good" stimulability scores.

(4) Although the effectiveness of articulation therapy would not depend upon the severity of articulatory defectiveness, subjects having "severe" rather than "mild" problems would make significant improvements.

(5) The mental ages of the subjects would not relate to the determined efficacy of articulation therapy.

PROCEDURE

Locating Subjects

Initial Screening. Subjects in the study were drawn randomly from a population of 353 educable-retarded children determined to have misarticulations. To locate these children, the speech clinicians who served on the project, in conjunction with 20 school speech clinicians who did not otherwise work on the project, examined all the children in attendance in 42 classes within the public schools of Montgomery County, Pennsylvania. A total of 630 children were examined from the 42 classes. The 353 children who were determined to have articulatory differences were located on the basis of a three-position articulation test (see Appendix A). Therefore, 57% of the educable-retarded children enrolled in the 42 classes were found to have some degree of articulatory deviation. Of this number, 15.9% or approximately 100 of the children were felt by the speech clinicians to have severe articulatory problems, 15.9% or approximately 100 were thought to have moderate degrees of difficulty, and 24.3% (the remaining 153) were considered to have mild or slight problems.

Diagnostic Testing

The initial identification of children having articulatory differences was, therefore, completed by a combined group of 27 speech clinicians working in conjunction with the Project Director. Once the preliminary screening was accomplished, children were sorted into the severity categories previously described. Speech clinicians then began the process of examining all 353 subjects on a modified version of the Carter/Buck Prognostic Test and a version of the McDonald Picture Deep Test of Articulation (see Appendices B and C, respectively). Once this additional testing was completed, all the speech clinicians involved met with the Project Director for the purpose of sorting subjects into categories based upon their performances on each of these two speech testing instruments.

Final Selection Procedures

Subsequently, the seven raters and the Project Director identified subjects having less than 90 defective phonetic contexts on the 21 phonemes (148 were found in the group of 353) and the population of subjects having more than 90 defective phonetic contexts on the 21 phonemes (a population of 159 were identified). The next step in the selection procedure involved locating within each of these two subgroups those subjects who were determined to have prognostic scores on the Carter/Buck test of from 0-25 (the "Poor" group). Fifty-one of the 148 subjects having 90 or fewer articulation errors met this criterion; 58 of 159 subjects having more than 90 defective phonetic context also qualified accordingly. The second level of performance on the Carter/Buck test was for those subjects having the "good" scores. By inspection, it was determined that the most expedient cutting point for the upper group (or the group having the "good" prognostic scores) began at a score of 36 and went to the highest score possible, i.e., 100. The numbers of subjects qualifying in each of the two severity groups for the scores of from 36-100 were 75 in the group having less than 90 defective context and 68 in the group having more than 90 defective context.

The remaining steps in completing subject selection involved randomization procedures. For all of these purposes, a table of random numbers was utilized (Edwards, 1960). Procedures involving selecting within each of the two articulatory defectiveness groups, i.e., those having less than 90 defective context, 45 subjects having prognostic scores of from 0-25, and 45 subjects having prognostic scores of from 36-100. Those subjects unselected were not included in the project and, as mentioned, selection was determined on the basis of the use of random numbers. The final procedure consisted of using the table of random numbers and selecting subjects on the basis of the experimental group categories. In this regard, 15 subjects were selected from each of the articulatory defectiveness groups whose Carter/Buck scores were from 0-25 to receive therapy four times per week, therapy once per week or serve as controls. This procedure was also carried out identically for subjects in each of the severity groups having prognostic scores of from 36-100, and 15 subjects in each of the two groups having scores in this category were randomly assigned to one of the three treatments. (See Appendix D for a three-dimensional view of the experimental design).

Affects of Randomization upon Subject Variables

Mental Age, Chronological Age and IQ. The affects of randomization on certain variables related to subjects and not controlled within the design of the study, can be seen in Table 1. The typical subject in the study had a chronological age of approximately nine years, an average mental age of about a six-year-old child, and an average IQ of 70. Furthermore, his family tended to come from the lower socioeconomic stratum. The mean chronological ages, mental ages, IQ's and socioeconomic classes are contained in Table 1. A series of F tests were conducted to determine the significance of the mean differences for each of the variables contained in this table. None of the F ratios were significant. A similar analysis was performed for the same variables for each of the 12 experimental groups. Again, none of the F ratios were

Table 1. Mean chronological ages, mental ages, intelligence quotients, and socioeconomic classes for three experimental groups. (N = 60 per group)

Group	Mean CA	Mean MA	Mean IQ	Mean SE*
Experimental 4 times per week	108.25	71.27	70.37	4.91
Experimental 1 time per week	105.17	76.12	72.30	4.73
Control	105.38	72.18	68.35	4.95

*Socioeconomic levels were determined using the Minnesota Scale of Parental Occupations (1936). In three instances it was necessary to use maternal occupations since the fathers of the subjects were deceased.

Table 2. Mean chronological ages, mental ages, intelligence quotients, and socioeconomic classes for subjects in the 12 groups. (N = 180)

Group	Type	Mean CA (Mos.)	Mean MA (Mos.)	Mean IQ	Mean SE
A	Moderately defective, poor stim., control	114.58	77.91	68.00	4.54
B	Moderately defective, poor stim., therapy once weekly	105.73	78.25	74.01	4.40
C	Moderately defective, poor stim., therapy 4 x weekly	103.38	72.26	69.90	4.00
D	Moderately defective, good stim., control	106.80	72.65	68.03	5.13
E	Moderately defective, good stim., therapy once weekly	106.67	79.93	74.94	4.47
F	Moderately defective, good stim., therapy 4 x weekly	108.93	80.17	73.06	5.13
G	Severely defective, poor stim., control	98.14	67.70	68.99	4.31
H	Severely defective, poor stim., therapy once weekly	97.64	64.98	66.55	4.83
I	Severely defective, poor stim., therapy 4 x weekly	95.60	65.68	68.34	4.93
J	Severely defective, good stim., control	102.00	70.48	68.38	6.00
K	Severely defective, good stim., therapy once weekly	110.64	81.54	73.70	5.21
L	Severely defective, good stim., therapy 4 x weekly	95.42	66.96	70.17	5.57

Table 3. Mean Carter/Buck prognostic speech scores and standard deviations for 12 experimental groups.

Group	Type	Mean Carter/Buck Prognostic Score	S.D.
A	Moderately defective, poor stim., control	8.36	2.55
B.	Moderately defective, poor stim., therapy once weekly	8.20	3.15
C	Moderately defective, poor stim., therapy 4 x weekly	9.71	3.25
D	Moderately defective, good stim., control	66.47	8.75
E	Moderately defective, good stim., therapy once weekly	72.06	10.38
F	Moderately defective, good stim., therapy 4 x weekly	73.40	9.98
G	Severely defective, poor stim., control	11.50	2.99
H	Severely defective, poor stim., therapy once weekly	17.85	4.10
I	Severely defective, poor stim., therapy 4 x weekly	10.47	2.66
J	Severely defective, good stim., control	51.13	12.06
K	Severely defective, good stim., therapy once weekly	54.20	11.10
L	Severely defective, good stim., therapy 4 x weekly	45.21	9.95

significant. The means for the variables of chronological age, mental age, IQ, and socioeconomic class are contained in Table 2.

Carter/Buck Prognostic Scores. Table 3 contains the mean Carter/Buck prognostic scores and standard deviations for the 12 experimental groups. The mean Carter/Buck prognostic score for subjects within the category of from 0-25 was 11.01 with a standard deviation of 3.47. The mean Carter/Buck score for subjects within the category of from 36-100 was 60.42 with a standard deviation of 10.90. A t-test revealed that these mean differences were significant beyond the .001 level (t of 4.78, df = 179). Therefore, a highly significant difference between prognostic speech scores was achieved and was determined between groups of subjects having "poor" scores and those having "good" scores.

Rater Reliability

Picture Articulation Test. This was a research version of McDonald's picture test which measured each phoneme 15 times as it served as an "initiator" of a syllable and 14 times as it served as an "arrester" of a syllable. The phonetic contexts assessed can be seen in Appendix C.

Sentence Deep Test. This is included as Appendix F. McDonald worked cooperatively with the author to adapt his standard sentence test for use with educable-retarded subjects. In order to do this the vocabulary and mean sentence length was reduced to conform to the auditory memory for sentence abilities of such subjects.[2]

Training Raters. The seven raters who served in this project received a week of intensive training prior to the inception of the study. During the month of August 1967, raters reviewed techniques and procedures for administering and scoring McDonald's picture deep and sentence tests of articulation. Training tapes were used in order to improve the agreement among raters concerning correct and incorrect responses of persons defective in articulation. Additionally, subjects were located who were in attendance at a special summer speech and hearing program, and these were used for rater training. Reliability training was based upon the same type of judgment used when the dependent variables were measured, viz., judgments were made of the correctness or incorrectness of an articulatory response; and other determinations of the nature of the error, such as whether it represented an error of omission, substitution, distortion, or addition were not included.

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[2] Field trials by raters were completed by testing the auditory memory for sentence abilities and resulted in the decision to limit sentences to no more than five words.

Nature of the Raters. Five of the seven raters had one or more years of experience giving the McDonald deep tests. Three of the raters had participated prior to this study in similar research utilizing these instruments. The five raters having experience with the McDonald Deep Tests had previously evidenced excellent intra-group mean agreement on the types of judgments used in this project, as observed in other research in which they participated as raters, and also in some of the trial experiences provided for them in attempting to improve reliability.

Pre- Test Reliability. Prior to the Pre-testing session and before the period in which subjects were located for this project, the seven raters met with the Project Director for purposes of assessing their intra-group mean agreement on judgments of correct and incorrect. For this purpose, seven mentally retarded subjects having misarticulations and not used as subjects in the project were located. The seven subjects evidenced different degrees of severity of articulatory defectiveness. Using a procedure of having one of the numbers test a subject while the remainder watched, listened, and judged, each rater scored his responses to the picture articulation test independently. The mean agreement of the raters on the seven subjects prior to the actual Pre- testing (as seen in Table 4) was 86.86% for all of the 21 sounds measured.

Post I Reliability. Approximately one week prior to the Post I testing, or during the last week of May 1968, the raters again met with the Project Director for purposes of determining reliability on the picture articulation test, and also on the newly developed deep test which utilized sentences. Intra-group mean agreement was determined, therefore, on each of these dependent variables utilizing a population of nine educable mentally retarded children having misarticulations who were not included as subjects in the study. The procedures used in deriving a response for the subjects were identical to those used in the Pre- testing; raters determined the correctness or incorrectness of each child's responses independently, and the necessary computations indicated that the percentage of intra-group mean agreement on the picture test one week prior to the Post I testing was 88.10%. For the sentence test, and again assessing all 21 phonemes, the percentage was somewhat less, being 82.22%.

Post II Reliability. One week prior to the Post II testing, or on or about September 10, 1968, the same seven raters met with the Project Director for purposes of determining their intra-group mean agreement for the 21 phonemes. For this purpose, eight educable-retarded children having misarticulations were tested. None had served as subjects in the project. The procedures used for making rater judgments, scoring procedures, and computational procedures were identical to those used in both prior determinations. The intra-group

Table 4. Intra-group mean agreement for 7 raters on 21 phonemes under study, measured on the picture articulation test and the sentence articulation test, across 3 time periods.

Phoneme	*Testing Periods				
	Pre	Post I		Post II	
	Picture Test	Picture Test	Sentence Test	Picture Test	Sentence Test
1. /s/	91.75%	90.35%	88.50%	93.01%	90.03%
2. /z/	90.55%	89.90%	91.93%	91.82%	90.10%
3. /r/	91.90%	92.55%	86.73%	94.49%	89.25%
4. /ɚ/	90.35%	91.72%	90.05%	88.85%	91.42%
5. /ɝ/	95.50%	93.75%	91.96%	90.80%	87.75%
6. /θ/	92.58%	97.33%	94.45%	100.00%	93.64%
7. /ð/	77.35%	80.15%	75.50%	69.95%	67.14%
8. /l/	93.30%	95.50%	90.17%	94.78%	89.41%
9. /tʃ/	86.62%	88.50%	81.70%	84.78%	82.43%
10. /ʃ/	87.75%	90.00%	80.05%	83.30%	79.90%
11. /dʒ/	79.90%	83.36%	75.55%	89.91%	80.10%
12. /j/	85.10%	80.92%	76.75%	83.20%	80.95%
13. /k/	94.44%	91.77%	93.35%	99.40%	100.00%
14. /g/	86.60%	88.35%	79.33%	97.70%	66.10%
15. /ŋ/	50.05%	53.35%	40.80%	59.90%	51.10%
16. /t/	78.80%	77.70%	62.20%	80.01%	66.25%
17. /d/	90.05%	91.10%	73.66%	93.30%	90.00%
18. /p/	89.90%	91.10%	83.73%	93.10%	80.00%
19. /b/	79.83%	87.75%	89.91%	90.03%	84.45%
20. /f/	96.60%	97.70%	89.90%	93.77%	100.00%
21. /v/	95.23%	97.30%	90.55%	100.00%	99.77%
Intra-group mean agreement	86.86%	88.10%	82.22%	89.15%	83.80%

*The following number of subjects were used to assess rater reliability: Pre-testing, 7; Post I testing, 9; Post II testing, 8. The same S was used for both the picture and sentence testing at the Post I and Post II times.

percentage of mean agreement among raters for the picture test at the time of the Post II testing was determined to be 89.15%; for the sentence test, this percentage of agreement was 83.80%. It can be observed that the percentage of intra-group mean agreement among raters was consistently higher for the picture test contrasted with the sentence test.

Some aspects of reliability assessment as used in this project possibly should be noted. Firstly, attempts were made to make the identical types of judgments using the same testing procedures and following the same scoring procedures used when the actual Pre-, Post I and Post II testing was completed by the raters. Secondly, the population of subjects used for determining reliability was randomly drawn from the same parent population of children who served as subjects in the study, i.e., they were educable-retarded children from the same school classes having misarticulations and not used as subjects in the project. Thirdly, it should be observed that phonemes on which rater reliability was lowest appeared rather infrequently misarticulated in the speech of the actual subjects used in the project (see Table 8). For example, the total number of articulatory errors at the time of the Pre- testing for all 180 subjects was 21,466. Of this number 20,342 errors on the Pre-testing occurred on only 12 sounds. These were: /θ/, /ð/, /r/, /ɝ/, /ɚ/, /s/, /z/, /ʃ/, /tʃ/, /l/, /v/, and /d /. Therefore, 94.76% of all the errors for all 180 subjects occurred on these sounds. The intra-group mean rater reliability for these 12 sounds was computed for the picture articulation test separately, the sentence test separately and for the combined two tests across all testing periods. It was determined that the intra-group mean percentage of rater agreement for the 12 sounds on the picture articulation test was 90.04%. For the sentence test, the intra-group mean percentage of agreement among the seven raters for the Post I and Post II testings combined was 86.60%. The total rater reliability for these 12 sounds for the combined picture and sentence tests for all three testing periods was determined to be 88.66%.

It would appear that rater reliability, as reflected in intra-group mean percentage of agreement, tended to be about 90% across the chief dependent variable, namely, the picture articulation test. As can be seen in Table 4, the intra-group mean agreement for raters was greatest for those phonemes which accounted for the significant difference between treatment groups. For example, as seen in Table 8, the amount of change in the groups of subjects who received therapy four times weekly tended to be on /θ/, /ð/, /s/, /z/, /l/, /ʃ/, and /tʃ/. These sounds tended to be in that group which had the highest rater reliability.

Articulation Testing. As noted previously, the same seven raters completed the Pre-, Post I, and Post II articulation testing on all subjects. The procedures in testing were kept constant throughout in the sense that the picture articulation test was administered prior to the sentence test for each subject at the Post I and Post II times. Other commonalities in the articulation testing, as completed by the seven raters, included the following:

a. Each child who served as a subject in the project was tested individually in a room chosen within the school for its remoteness from noisy activities and interruptions.

b. At the time of the Pre- testing, when only the picture articulation deep test was administered, each rater gave each subject five trials on non-test items in order to get him to comprehend the nature of the task. Special emphasis was made to insure that the two consecutive words were articulated rapidly enough to produce the proper degree of overlapping necessary to qualify as a deep-test measurement. In some instances it was necessary to give certain of the retarded children more than five trials on non-test items, since they were not able to produce the two words with sufficient speed to allow this to happen. In later testing, that is, at the Post I and Post II times, most of the educable-retarded children were experienced in taking the test and it was unnecessary to coach many of these children in order to get them to complete the tasks in an acceptable manner.

c. Rather typically, subjects who happened to be within the same class or who were involved in the same school building were tested on the same day. In some cases, it was necessary for raters to return to a school within the same week or as soon as possible to complete the testing on children who were absent on the day on which the school was visited. Generally, however, testing for all subjects during each of the three time periods was completed within one week's time by all seven raters. Additionally, raters tended to test on exactly the same days during each of the time periods.

d. All raters used identical picture articulation tests and sentence tests (see Appendix C and Appendix F).

Monthly Picture Articulation Testing on Selected Subjects. Forty-seven subjects were examined by the same seven raters on a monthly basis beginning in October 1967 and ending in

May 1968. All were measured on the same modified version of McDonald's Picture Deep Test. The intention was to graph the changes on error sounds of randomly selected subjects from each of the three experimental groups and present these as supportative information concerning the effectiveness of treatment. There were 19 control subjects examined monthly, 14 subjects who received therapy one time a week, and 14 subjects who received therapy four times a week. Comparisons were made of changes in their total articulatory profiles on a monthly basis. Separate analyses for subjects from the three groups were made of changes in the production of phonemes as a function of the two independent variables, viz., initial stimulability performances and initial levels of articulatory defectiveness (severity). An additional analysis was completed showing the changes in these subjects on each of the 21 phonemes under investigation in the project. This special monthly articulation testing on selected subjects from each of the experimental groups was completed during the latter part of each month during the nine month experimental period. The procedures in examining were identical to those employed in the Pre-, Post I, and Post II picture articulation testing. The seven raters generally completed this testing in one day; however, in a few instances testing had to be completed on a subsequent day due to absences from school and other difficulties.

Any influence of repeated experiences with picture articulation testing in elevating Post scores seemed to have been compensated by the fact that comparable numbers of subjects from each group were examined monthly during the treatment period.

Rater-Subject Familiarity

None of the seven raters provided speech therapy to subjects whom they tested. None of the raters saw any subjects for any purposes between the testing interims, i.e., Pre, Post I, and Post II. Furthermore, none of the seven raters had knowledge concerning whether tested subjects were from one of the two treatment groups or from the control group. Care was also taken to insure that raters did not have knowledge of prior levels of articulatory performances on each of the phonemes tested. Of course, it was necessary to inform each rater concerning which phonemes were defective and must be tested.

THERAPY

Orienting Teachers To The Project

Early Activities. Many of the 42 teachers of educable retarded children within the schools of Montgomery County, Pennsylvania, became familiar with the project, on or about the time that the subject selection was completed. Each of the 27 speech clinicians on the staff spoke personally with each of the teachers concerning: a) lack of available speech correction services at the present time for such children; b) Wilson's reported findings indicating that under some conditions educable retarded children may not benefit from speech correction; c) assessment of the nature of the effectiveness of speech correction within Montgomery County schools would make it necessary to provide intensive therapy to some children weekly, rather minimal one-time-a-week therapy for other children weekly, and no therapy for some population of children during the course of the school year. All teachers were told that reported outcomes of this experiment would be made available to them; that under extreme circumstances of need or hardship and/or strong parental objection, subjects would be either entered into therapy on a different basis and/or dropped from therapy. Some portion of school administrators also received identical information concerning the nature of the project.

Developments During the Project. During the course of the project, the Project Director met with the local branch of the Council for Exceptional Children to discuss the project. A number of the teachers of the retarded children who were involved in the study were in attendance. The Project Director discussed the nature of the project, its specific goals, and reviewed some aspects of the literature concerning the efficacy of speech correctional procedures for retarded children. Additional clarification was accomplished during this time and the meeting appeared to be successful in gaining improved understanding and acceptance of the project.

The Nature Of The Clinicians. Four speech clinicians provided the therapy to the educable-retarded children in this project. Each of the four had volunteered to become a member of the Research Team and to complete this work. The nature of the selection of the personnel might be of interest. The "team" of clinicians was constituted on the basis of a balance between experienced individuals and relatively inexperienced speech clinicians. Two of the speech clinicians who worked with the children in the project had five or more years of experience as staff members of the Montgomery County, Pennsylvania, Speech and Hearing Program. Both Robert Leiss and Dolores Fundrella had part-time supervisory responsibilities on the Montgomery County Schools Speech and Hearing Staff. Both of these persons were considered outstanding in terms of their demonstrated effectiveness in providing articulation therapy to children in the public schools. Both had previously been involved in similar research. The second two members of the team were relatively inexperienced speech clinicians. Patricia Oerther had six months prior experience as a speech clinician working with retarded children on the staff of Montgomery County Schools. Mr. Ralph Sholly had recently received undergraduate training at Bloomsburg State College and was beginning his professional work. A breakdown of the degrees, experiences, and accreditation of these individuals is presented.

THERAPY STAFF

Name	Degree	Years Experience	Certification State	Certification ASHA
Robert H. Leiss	M.Ed.	7	Speech	CCC Speech
Dolores Fundrella	B.S.	6	Speech	CCC Speech
Patricia Oerther	B.S.	1/2 year	Speech	None
Ralph Sholly	B.S.	0	Speech	None

In summary, the selection of speech clinicians for this project was compatible with a principle designated for it, viz., that the project be somewhat representative of the types of experiences, of procedures, and staff which might be found in many school speech therapy programs conducted in the United States. To that end, the "team" of clinicians who served the retarded children was a balance of experienced and inexperienced staff members.

Articulation Therapy Procedures

Training and Supervision of Clinicians. The four speech clinicians, who provided the group articulation therapy to the subjects in this project, received prior training and preparation for their assignments. This training was conducted by the Project Director and was aimed chiefly at increasing the competencies of the two less-experienced staff members. The two experienced staff members assisted the Project Director in training the two less-experienced individuals on methods of gaining sound production, the types of phonemic patterns of defectiveness in retarded subjects, implication for the selection of phonemes to be improved, techniques of ear training suitable for use with such children, problems in motivating retarded children to better speech and the importance of establishing appropriate sub-goals at each therapy session. Additional training prior to the inception of the project was conducted by the Project Director and his associates which was aimed at the utilization of tape recording instruments such as the Echorder, and the value of a mirror in articulation therapy. During the course of the project, each of the clinicians met with the Project Director on a montaly basis to consult about problems and receive suggestions about therapy techniques. The Project Director and, in particular, Mr. Robert Leiss, visited each speech clinician at a time when therapy was being conducted. This on-the-job supervision was accomplished more frequently for the two less-experienced staff members. They were also observed doing therapy with the retarded children in the project; however, these observations were limited in number, since the individuals had proven competencies and were considered to be effective clinical workers.

The four speech clinicians in the project and the Project Director met on a group basis on the average of twice monthly during the nine-months experimental period. Efforts were made to increase the homogeneity of therapy techniques through discussion of particular children, their progress, their problems, and the goals of therapy for them. Prior to the inception of the project, the Project Director had reviewed a syllabus of articulation therapy training activities and discussed the principles and practices in some depth with the four clinicians. During the course of bimonthly meetings with the entire group, the procedures and principles were again restated and reformulated.

Principles of Therapy. One of the principles which guided the therapy of all four speech clinicians was that one defective phoneme be identified for each of the educable retarded children and efforts made to advance this sound through various stages consisting of: 1) correct production in isolated form; 2) increasing articulatory proficiency of the sound through the use of nonsense syllables, emphasizing correct production and various consonant/vowel combinations through various patterns of inflection, intonation, stress, and speed; 3) the correct utilization of the phoneme in words; 4) the correct use of the phoneme in phrases, reading material, and spontaneous speech. This basic evolution of articulation improvement was followed by all of the four persons who provided the therapy in this project.

The importance of efficient group management of the subjects was also stressed in the training procedures and was made a focal point of supervision in the schools. Principles of group articulation therapy, previously outlined by the Project Director in written form, were reinforced to the four speech clinicians. The value of instruments, such as the Echorder, the use of a mirror, and speech home assignments were frequently stressed. In regard to the latter, it should be noted that all 120 subjects who received therapy in this project had assigned speech notebooks. Efforts were made to get subjects to use these notebooks, yet these efforts were not considered any more stringently enforced than those efforts usually made when children with comparable problems of normal ability received articulation therapy.

Parental Involvements. In order to keep the project representative of speech therapy efforts commonly provided to articulatory defective children of normal ability throughout the United States, the involvement of parents in the therapeutic process was kept at a minimal level. The parents of each of the children were invited to school to talk with the speech clinician and observed therapy twice during the nine-months treatment period. Approximately 20% of the parents invited attended. Activities for the parents and training were limited to discussions and occasional demonstrations of tasks represented in the children's speech notebooks. Furthermore, the goals of the speech program were stated for the parents, and they were urged to assist the children in certain aspects of their articulatory deficiency. Contacts were generally limited to less than 30 minutes per conference. In most cases, repeated contacts with parents were not made and "training" in any systematic or intensive manner was not conducted. These "marginal" contacts, again, appeared to be rather representative of general practice in articulation therapy as conducted in schools. It was felt important in the project not to introduce a variable which has been found to relate to increased therapy effectiveness (Sommers, 1962, 1964); rather, to keep the efforts at assessing the degree to which articulatory educable retarded children benefit from therapy restricted almost chiefly to the influence of the speech clinician.

Teacher Involvements. This same principle applied to the degree to which teachers assisted in the speech correctional process in the present study. Teachers were appraised of each child's problem, frequently knew which phonemes were being stressed in the correctional process, and were occasionally asked to try to get a child to produce the sound correctly in reading and perhaps even in spontaneous speech. However, no formal training program for the classroom teachers of the educable retarded children was conducted. No training syllabus was provided for the teachers indicating how they could be of value in the therapy process. No teacher observed any of the actual speech therapy being conducted for her children. Teachers did see the home assignments in the speech notebooks. Efforts were made to discuss some of the problems which were encountered in providing therapy to particular children such as behavioral problems, discipline problems, problems involving adjustment, and some of those which might involve motivation for better speech. Generally, teachers' influences in the correctional process were kept at a rather minimal level, and as stated, no special efforts were involved to increase the teacher's role.

Group Articulation Therapy. Group articulation therapy was conducted for all 120 subjects in periods of 30 minutes duration. Sixty of the 120 subjects received one period of group articulation therapy weekly; sixty of the subjects received four periods of group articulation therapy on different days each week. The mean number of children in the group articulation therapy conducted once weekly was 3.90; the mean number of subjects in the classes of children who received four periods of articulation therapy weekly was 4.10. The range of children in classes in either group was from three to five. Therefore, the smallest group of children in a class was three and the largest was five, and the means were essentially the same.

Methods

The articulation therapy used for both groups of experimental subjects might be classified generally as the Phonetic-Placement approach advocated by Van Riper (1963, pp. 220-221) and described by Berry and Eisenson (1956, pp. 163-164). In addition, some of the activities similar to those described by Van Riper (1963) were included. Also, certain aspects of the Sound-Stimulation Method of articulation therapy as discussed by Berry and Eisenson (1956, pp. 162-163) and Johnson et al (1956, pp. 126-129) supplemented the Phonetic-Placement method. A number of the activities in the phonetic-placement series involved related procedures discussed by Van Riper (1963) and described as the Method of Approximations. Therefore, speech clinicians frequently worked to "shape" a child's production of the phoneme, trained him to discriminate its acoustic parameters, and attempted to evolve a correct production. Principles of the Sensory-Motor Articulation Therapy Methods as advanced by McDonald (1964) were used sparingly with some of the children.

In summary, the articulation therapy methodologies and procedures were not radically different from those which are frequently outlined in popularly used speech correctional texts and probably rather widely used in articulation therapy throughout the United States. The correction of phonemes typically involved emphasizing one for a particular child, but may have included the stimulating of some subjects on other defective sounds. In this regard, some children received discrimination ear training and made judgments concerning "right/wrong" on other defective sounds. Under some conditions, selected children received therapy on

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[3] Due to scheduling of problems and the needs of children, it was not possible to maintain four children in each group articulation therapy class, although this generally was the case. It was necessary to allow a few classes to have only three children in them, and in some cases, to place five children in one class.

more than one phoneme, and the choice of other phonemes was dependent upon the degree to which they could be modified towards correction.[4]

Amount of Therapy Provided. For the sixty subjects in the project who received articulation therapy for four 30-minute periods weekly, the possible number of sessions during the nine-months school year was 119. For the sixty subjects who received group articulation therapy for one period of 30-minutes duration each week, the possible number of sessions was thirty. For the former group, the range of number of sessions was 75-96; the mean was 90.05; and the standard deviation was 5.12. For the latter group the range was 23-30; the mean was 25.70; the standard deviation was 2.15. It can be seen, however, that subjects provided with therapy four times weekly received three and a half times more treatment than those who received it once weekly. Obviously, not only was the number of sessions very significantly greater for the four-times-a-week group, but the administration of such therapy, in terms of its intensity, was also markedly different.

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[4] The practice of providing stimulation on more than one defective phoneme is consistent with the articulation beliefs and practices of speech clinicians in the Montgomery County, Pennsylvania, Schools. This "multi-directed" therapy is usually predicated on measurements of the consistency of misarticulation of a phoneme and the degree to which changes towards correction can be manifested in stimulability testing.

RESULTS

Data Analysis

A special program for a three-factor, factorial analysis of variance design was written and used on an IBM 360 computer to test the main effects and interactions of the two dependent variables, viz., picture articulation difference scores and sentence scores. Additionally, correlation coefficients, regression coefficients, tests for kurtosis, and many of the means and standard deviations were also derived from computer analysis. Other statistical procedures were completed manually using an electric calculator.

Cell Size

Five subjects were lost in the study from the Pre- to the Post I period. Two of these subjects were tested by raters who traveled to other counties in Pennsylvania after receiving the approval and cooperation of school officials. Therefore, three cells at the time of the Post I testing contained 14 rather than 15 subjects. The technique of data substitution was employed to bring three cells, each with an N of 14, back to the original level of 15. Mean values were substituted for one missing subject in each of the three cells. This procedure resulted in the loss of three degrees of freedom. At the time of the Post II testing, three months after the Post I testing, five additional subjects had moved from Montgomery County, Pennsylvania. Again, it was possible to locate these subjects; raters gained the necessary cooperation and traveled to other areas to complete the testing. One subject had moved more than 200 miles, two had moved into two surrounding counties, one had moved to neighboring New Jersey, and one had moved to a different school district within the county. Since all five subjects were located, examined, and included in the project, no additional adjustments were necessary in order to keep the cell size uniform at 15 and the final analysis consisted of a total N of 180 subjects.

Main Dependent Variable: Picture Articulation Difference Scores

Pre - Post I. This consisted of difference scores derived from comparing Pre- and Post I picture articulation scores. Articulation error scores were determined at the time of the Pre- testing for each subject and again at the time of the

Post I testing. Difference scores were obtained by subtracting the Post II scores from the Pre- scores for each subject. Table 5 contains the Pre- and Post- mean scores and standard deviations for subjects in the 12 experimental groups. As noted, there were 15 subjects included in each cell. The mean improvement for 60 subjects who received therapy four times a week was determined to be 32.00; the mean for those receiving therapy one time a week was 16.75; and the mean for the control group subjects was 5.72. Table 6 contains a three-way analysis of variance for the 12 groups of subjects based on a Pre - Post I comparison of their picture articulation scores. It can be seen that a significant Therapy effect obtained. Neither of the two other main factors or any of their interactions were significant. In order to test the main effect among the three experimental groups, a series of independent *t* tests were completed. The results of these analyses, contained in Table 7, indicated that the significant difference for the Therapy effect existed between the group of subjects who received therapy four times weekly and the control group. The *t* of 3.21 was significant at <.01 level of confidence (*df* = 118). No significant difference at the .05 level was determined between the group of subjects who received therapy once weekly and the control group. Therefore, a significantmain effect for Therapy was a result of the difference in performances of subjects from the four times a week group and the control group subjects.

Table 8 contains an analysis of the Pre- and Post- picture articulation testing results for each of the three experimental groups as a function of each of the 21 phonemes under investigation. The significant main Therapy effect for subjects who received articulation therapy four times weekly can be seen in this table according to changes in the phonemes. It can be noted, for example, that the following phonemes accounted for much of the change and improvement in subjects who received therapy four times weekly: /θ/, /ð/, /s/, /z/, /ʃ/, /l/, and /tʃ/. It can further be observed in this table that these were the phonemes on which subject errors were initially the highest among all three groups. Therefore, the precise nature of the articulatory improvements for subjects from the three experimental groups can be seen in this table, and the specific nature of the phonemes accounting for this effect is readily apparent.

Post I - Post II. Table 9 contains the mean picture articulation difference scores for the 12 experimental groups at both the Post I and Post II periods. The Post I period was at the end of the treatment period for subjects, that is, June 1968. The Post II period was approximately three months later in September 1968.

An analysis of variance of picture articulation difference scores for the 12 groups based upon such a Post I and Post II comparison is contained in Table 10. It can be observed that

Table 5. Pre- and Post- score means and standard deviations of articulation scores for 12 experimental groups. (Total N = 180 with 15 per cell)

Group	Type	Mean Pre Score	Mean Post Score	Pre SD	Post SD
A	Moderately defective, poor stim., control	63.07	60.93	24.50	32.97
B	Moderately defective, poor stim., therapy once weekly	71.80	55.33	14.00	23.94
C	Moderately defective, poor stim., therapy 4 x weekly	68.86	41.21	24.30	33.30
D	Moderately defective, good stim., control	58.67	46.27	14.63	25.80
E	Moderately defective, good stim., therapy once weekly	46.73	34.00	20.70	18.10
F	Moderately defective, good stim., therapy 4 x weekly	51.87	31.33	22.57	19.53
G	Severely defective, poor stim., control	188.27	177.87	41.60	42.90
H	Severely defective, poor stim., therapy once weekly	208.80	177.60	59.86	56.32
I	Severely defective, poor stim., therapy 4 x weekly	251.73	215.80	44.61	34.27
J	Severely defective, good stim., control	160.07	158.60	48.50	53.10
K	Severely defective, good stim., therapy once weekly	135.87	118.70	37.96	38.37
L	Severely defective, good stim., therapy 4 x weekly	175.07	130.86	43.66	32.40

Table 6. Analysis of variance of picture articulation difference scores for 12 groups of subjects based upon a Pre - Post I comparison.

Source	df	Mean Square	f	p
Between effects				
Therapy (Th)	2	622.53	6.86	<.005
Stimulability (St)	1	22.55		
Severity (S)	1	212.27	2.34	n.s.
Interaction				
Th x St	2	29.99		
Th x S	2	81.59		
St x S	1	20.78		
Th x St x S	2	86.81		
Within groups	165	90.76		
Total	176			

Table 7. Summary of independent t tests for picture articulation difference scores at the Post I period, analyzing the significant main therapy effect.

Groups Compared	Mean Diff.	S.E.	df	t	sig.
Therapy Four Times Weekly and the Control Group	26.28	8.18	118	3.21	$<.01$
Therapy Once Weekly and the Control Group	11.03	7.10	118	1.55	*n.s.

*not significant at .05 level

Table 8. Changes in defective speech sounds as a function of group articulation therapy.

Sounds Defective	Control Group Pre	Post	Diff.	Therapy Once Weekly Pre	Post	Diff.	Therapy Four Times Weekly Pre	Post	Diff.
1. /θ/	795	718	+77	892	551	+341	958	355	+603
2. /ð/	911	813	+98	924	760	+164	752	466	+286
3. /s/	536	535	+ 1	531	505	+ 26	735	601	+134
4. /z/	710	658	+52	764	685	+ 79	964	811	+153
5. /l/	625	602	+23	666	593	+ 73	727	609	+118
6. /ʃ/	342	381	-39	300	303	- 3	406	364	+ 42
7. /tʃ/	211	254	-43	292	261	+ 31	369	261	+108
8. /r/	768	775	- 7	623	559	+ 64	715	673	+ 42
9. /ɚ/	424	377	+47	236	217	+ 19	308	299	+ 9
10. /ʒ/	679	691	-12	462	417	+ 45	526	569	- 43
11. /v/	326	257	+69	279	184	+ 95	271	238	+ 33
12. /g/	49	49	0	55	29	+ 26	113	79	+ 34
13. /d/	150	140	+10	119	126	- 7	171	144	+ 27
14. /dʒ/	294	235	+59	227	186	+ 41	366	301	+ 62
15. /ŋ/	3	13	-10	54	22	+ 32	103	80	+ 23

(cont'd.--)

Table 8. (cont'd.)

Sounds Defective	Control Group			Therapy Once Weekly			Therapy Four Times Weekly		
	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
16. /t/	124	102	+22	87	83	+ 4	62	63	- 1
17. /k/	41	11	+30	59	49	+10	112	69	+43
18. /p/	6	11	- 5	1	2	- 1	51	28	+23
19. /b/	6	15	- 9	14	4	+10	48	25	+23
20. /f/	37	15	+22	3	0	+ 3	72	62	+10
21. /n/	12	0	+12	-	-	-	-	-	-

Table 9. Mean picture articulation difference scores for 12 experimental groups at the Post I and Post II periods. (Post I scores = Pre-Post I; Post II scores = Post I-Post II). N = 15 per cell.

Group	Type	Mean Post I	Mean Post II
A	Moderately defective, poor stim., control	2.14	+2.27
B	Moderately defective, poor stim., therapy once weekly	16.47	+2.07
C	Moderately defective, poor stim., therapy 4 x weekly	27.65	-1.13
D	Moderately defective, good stim., control	12.40	-2.60
E	Moderately defective, good stim., therapy once weekly	12.73	+6.33
F	Moderately defective, good stim., therapy 4 x weekly	20.54	+1.53
G	Severely defective, poor stim., control	10.40	-11.13
H	Severely defective, poor stim., therapy once weekly	31.20	-1.27
I	Severely defective, poor stim., therapy 4 x weekly	35.93	-13.00
J	Severely defective, good stim., control	1.47	-3.87
K	Severely defective, good stim., therapy once weekly	17.17	+2.47
L	Severely defective, good stim., therapy 4 x weekly	44.21	-3.20

Table 10. Analysis of variance of picture articulation difference scores for 12 groups of subjects based upon a Post I - Post II comparison.

Source	df	Mean Square	f	p
Between effects				
Therapy (Th)	2	48.34		
Stimulability (St)	1	35.33		
Severity (S)	1	138.24	3.22	<.10
Interactions				
Th x St	2	4.05		
Th x S	2	8.72		
St x S	1	36.79		
Th x St x S	2	11.08		
Within groups	165	42.88		
Total	176			

none of the main effects or any of the interactions were significant. The mean changes for the control group subjects, subjects receiving therapy one time weekly and subjects receiving therapy four times weekly were -3.83, +2.40 and -4.26, respectively. Therefore, no significant changes occurred during the Post I and Post II periods for subjects as reflected in an analysis of picture articulation difference scores. Presumably, greater improvement for subjects in the four-times-a-week group, reflected in an analysis of Pre-Post II scores, was retained at the time of the Post II testing since group mean changes were not significantly different for the three groups at that time.

Secondary Dependent Variable: Sentence Articulation Error Scores

Post I Time. At the time of the Post I testing, the imitated sentence articulation test was administered. The mean number of articulatory errors on the 21 phonemes for the Post I and the Post II testing on this sentence test are contained in Table 11. It can be observed that the mean differences for subjects in each of the 12 cells at the Post I period were relatively small within each of the three experimental groups. For example, the mean articulation error score on the sentence test for the control group subjects at the end of the Post I period was 42.55; the mean at the end of the Post II testing was 40.26; the mean for subjects who received therapy one time weekly at the end of the Post I period was 35.93; the mean at end of the Post II period was 36.84. The mean of the subjects who received therapy four times weekly was 39.64 at the end of the Post I period; the mean was 39.58 at the Post II period. The relative stability of the means among the three treatment groups, viewing across the Post I - Post II periods on the sentence test, is also well-reflected in the analysis of variance of sentence articulation scores contained in Tables 12 and 13. It can be noted that the mean difference for subjects in three groups were not significant on the sentence articulation test at either one of the specified time periods. Additionally, that the influences of factors such as stimulability and severity were consistently demonstrated in each of the two independent assessments and analyses. In both analyses significant main effects for Stimulability and Severity were determined. In each of the analyses, also, a significant interaction for the Stimulability and Severity variables was demonstrated. In summary, the results of comparing the three experimental group subjects on error scores derived from an imitated sentence articulation test indicated: 1) no significant main effect for therapy at the Post I and Post II time periods; 2) virtually no change in subjects and relative group performances from one time period to the next; and 3) significant main effects for the Stimulability and Severity variables and a demonstrated significant interaction for the Stimulability and Severity variables. The results suggest a high consistency of performance on this measuring instrument.

Interrelationships of Variables

Table 14 contains correlation coefficients expressing relationships between each of ten variables. The relationships between each of the three independent variables, three dependent variables, and four additional ones involving the nature of the subjects were determined and are reported in this table. Indices of Skewness and Kurtosis for each of the distributions were determined using computerized programs. The results suggested that correlational analysis procedures based on assumptions of linearity and normality of distributions were not violated. All correlation coefficients significant at the .01 level of confidence[5] are designated by an asterisk in Table 14. Although some of these significant intercorrelations represent slight relationships between variables, they constitute findings of some importance.

Some of the more substantial correlations, contained in Table 14, such as that between factor C (severity of articulation) and factor F (articulation scores derived from sentences at the Post I period) are worthy of discussion. In the example just cited, the determined correlation coefficient of -.71 denotes a substantial negative relationship between sentence articulation scores and the severity of the subjects. Obviously, this is a highly expected finding in view of the fact that the severity variable was established as an organismic factor within the design and it would be expected that subjects having more severe problems would show more errors on a test measuring error scores and not difference scores. Other expected findings which are revealed in moderate degrees of relationship include those of variable E (picture articulation difference scores between Post II and Post III) and variable F (error scores on the sentence articulation test at the time of the Post I period). The negative correlation of -.41 again reflects the fact that groups of subjects evaluated on the picture test were assessed on difference score measurements; whereas, sentence scores were error scores. Therefore, the observed negative relationship represents the finding that subjects showing improvements as measured on difference scores tended to have fewer errors on the sentence test. Again, these results are expected and are apparently outcomes of the differences in the nature of the dependent variables. A correlation coefficient of -.33 between variable F (error scores derived from the sentence articulation test at the time of the Post I testing) and variable I (the mental ages of the subjects) shows a significant moderate relationship between these variables. The results suggest that subjects having higher mental ages made fewer errors on the sentence articulation tests administered at that time. A slightly

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[5] With an N of 180, all correlation coefficients greater than .22 have standard errors of less than .071 indicating that they will be significant beyond the .01 level of confidence.

Table 11. Mean sentence articulation error scores for 12 experimental groups at the Post I and Post II periods. (N = 15 per cell)

Group	Type	Mean Post I Score	Mean Post II Score
A	Moderately defective, poor stim., control	23.67	22.64
B	Moderately defective, poor stim., therapy once weekly	19.20	21.33
C	Moderately defective, poor stim., therapy 4 x weekly	15.93	17.07
D	Moderately defective, good stim., control	17.60	18.13
E	Moderately defective, good stim., therapy once weekly	11.87	14.20
F	Moderately defective, good stim., therapy 4 x weekly	13.20	13.00
G	Severely defective, poor stim., control	71.47	64.33
H	Severely defective, poor stim., therapy once weekly	66.73	67.78
I	Severely defective, poor stim., therapy 4 x weekly	80.13	79.80
J	Severely defective, good stim., control	57.47	55.93
K	Severely defective, good stim., therapy once weekly	45.93	44.07
L	Severely defective, good stim., therapy 4 x weekly	49.33	48.43

Table 12. Analysis of variance of sentence articulation scores at the end of the experimental period (Post I).

Source	df	Mean Square	f	p
Between effects				
Therapy (Th)	2	208.00		
Stimulability (St)	1	8,081.05	19.90	<.01
Severity (S)	1	79,885.00	196.76	<.01
Interactions				
Th x St	2	572.50		
Th x S	2	466.10		
St x S	1	2,722.00	6.70	<.05
Th x St x S	2	470.50		
Within groups	165	406.05		
Total	176			

Table 13. Analysis of variance of sentence articulation scores at the Post II period.

Source	df	Mean Square	f	p
Between effects				
Therapy (Th)	2	44.04		
Stimulability (St)	1	556.65	13.01	$<.005$
Severity (S)	1	6,056.55	141.60	$<.001$
Interactions				
Th x St	2	11.47		
Th x S	2	22.85		
St x S	1	203.94	4.79	$<.05$
Th x St x S	2	27.06		
Within groups	165	42.77		
Total	176			

lower and negative relationship was also determined between variable F and variable J (the IQ's of the subjects). This result suggests that subjects having higher IQ's may have tended to produce fewer errors on a sentence articulation test.

Two other correlation coefficients, one negative and one positive, both significant but of slight importance between factor B (the stimulability performance of the subjects) and factor F (error scores on the sentence test at the time of the Post I testing) can be seen in Table 14. The negative correlation of -.23 indicates that subjects with higher stimulability scores tended to make fewer errors on the sentence test. The positive correlation of .23 comparing factor B again with another factor, namely factor G (the socioeconomic levels of the subjects), indicated a slight moderate relationship. The result suggests that there is a mild relationship between the stimulability performance of the subjects and that subjects having higher stimulability performances tended to be from higher socioeconomic groups. Finally, the slight yet significant relationship between variable C (the severity of articulatory defectiveness of the subjects) and variables I and J (the mental ages and IQ's of the subjects, respectively) denoted the fact that subjects with lower mental ages and lower IQ's tended to have greater numbers of articulatory errors. Again, such relationships are slight.

Influences of Relationships Upon the Primary Dependent Variable. As contained in Table 14 the primary dependent variable of the project, namely variable D (picture articulation difference scores from Pre - Post II) showed non-significant relationships to the IQ's, mental ages, chronological ages and socioeconomic statuses of the subjects (this can be seen in Table 14 as variable D compared with variables G, H, I, and J). Therefore, in spite of the fact that very slight relationships obtained between mental ages and IQ's of subjects with severity of articulation defectiveness, this was not determined to be the case when these variables were related to determined improvements in articulation on the primary dependent variable.

The last correlation coefficient significant was that obtained from an analysis of the chronological and mental ages of the subjects. The correlation coefficient of .67 indicated the expected positive relationship for those variables in a population of retarded individuals.

Table 14. Correlation matrix for three dependent variables, three experimental independent ones, and four random ones.

	A	B	C	D	E	F	G	H	I	J	
A	1.00	.000	.000	-.153	-.125	.087	.112	-.005	-.065	-.067	A
B	.000	1.00	.000	-.040	.084	-.230	.225	.068	.126	.070	B
C	.000	.000	1.00	-.124	.167	-.714	-.138	.168	-.262	-.245	C
D	-.153	-.040	-.124	1.00	-.056	-.013	.060	-.039	-.010	.072	D
E	-.125	.084	.167	-.056	1.00	-.414	.055	.028	.066	.031	E
F	.087	-.230	-.714	-.013	-.414	1.00	.064	-.163	-.334	-.231	F
G	.112	.225	-.138	.060	.055	.064	1.00	.006	.067	.071	G
H	-.005	.068	.168	-.039	.028	-.163	.006	1.00	.675	-.222	H
I	-.065	.126	-.262	-.010	.066	-.334	.067	.675	1.00	.237	I
J	-.067	-.070	-.245	.072	.031	-.231	-.091	-.222	.237	1.00	J
	A	B	C	D	E	F	G	H	I	J	

LEGEND: A = Therapy
B = Stimulability
C = Severity
D = Picture II-I
E = Picture III-II
F = Sentence, Post I
G = Socioeconomic
H = Chronological Age
I = Mental Age
J = IQ

CONCLUSIONS

The Therapy Effect

The principal hypotheses tested in the experiment were:

(1) groups of subjects who received group articulation therapy for four periods per week would achieve significant improvements compared with subjects who received similar therapy one time per week and control group subjects, and

(2) groups of subjects who received group articulation therapy for one period each week during the nine-month experimental period would not be significantly improved compared with control group subjects.

The findings of the present study indicated that each of these two hypotheses was deserving of being accepted, i.e., the group of 60 subjects who received four periods per week of group articulation therapy did make significant improvements compared with 60 subjects who received therapy one time per week and 60 control group subjects. This assertion was based upon an analysis of articulation difference scores on a pre- and post- basis for the nine-month treatment period. This type of measurement constituted the chief dependent variable and was the basis for some of the comparisons felt to be most important. Additionally, groups of subjects who received only one 30-minute period of group articulation therapy weekly were not successful in making significant improvements in articulation compared with control group subjects. Although the mean improvements for subjects who received therapy one time per week was more than twice that of the control group, these differences were not significant at the .05 level of confidence. Interestingly, the trend of the group means during the nine-month period, based on difference scores derived from the picture articulation deep test, was for increasing therapy to result in increasing improvements. Obviously, in a project of this type there is no way of determining whether a significant therapy effect would have been obtained had a different experimental group been introduced, i.e., one in which subjects perhaps received two or even three sessions of group articulation therapy each week. However, the fact that subjects who received group articulation therapy four times weekly were found to have mean improvements which were almost six times greater than the control group, and subjects who received therapy once weekly had a mean improvement which was two and a half times the control group, tended to support the assertion that the trend of the means was for increasing improvement as a function of a number of therapy sessions and/or the intensity of therapy application.

In regard to the latter point, it is worth mentioning that in this particular experiment it was not possible to extract and evaluate the influence of "intensity" of group articulation therapy from "amount" of articulation therapy, since subjects who received therapy once weekly, in effect, had three and a half times less total number of sessions in contrast with those who received it four times a week. The variable of "intensity", therefore, was not assessed in a meaningful manner.

In view of the significant Therapy effect for subjects who received therapy four times weekly, as measured on a picture deep test, and the lack of significant finding on an imitative sentence deep test, some discussion of differences between the measurements seems to be important.

It should be noted that the picture articulation deep test was used in the study cited earlier (Sommers, 1967) which investigated the efficacy of articulation therapy for kindergarten, first, and second grade children. In this study, subjects who received one 45-minute period of group therapy once weekly made significant improvements compared with control group subjects. The present finding, based upon educable-retarded children, demonstrated that such improvements can be realized in a population of such children under the condition that a great deal more therapy is provided. As noted, retarded subjects in the present project who received one 30-minute period of articulation therapy weekly failed to make significant changes in contrast to control group subjects. Therefore, the speculation is that the amount of therapy and, perhaps, some aspect of its intensity became a critical factor in obtaining comparable and significant changes in the speech of educable-retarded children.

Changes in Phonemes on the Picture Articulation Test

The 12 phonemes studied in the 1967 project (Sommers, 1967) and the degree of improvement in each for experimental and control group subjects are contained in Appendix E . Comparisons with the results of the present project seem appropriate and of value. For example, it can be seen in Table 8. that the educable-retarded children in the present project who received therapy four times weekly were found to improve most on the following phonemes: /θ/, /ð/, /s/, /z/, /l/, /ʃ/, /tʃ/. A view of the results of the 1967 project on a population drawn from the same area of kindergarten, first, and second grade school children will show that the greatest changes in phonemes studied occurred on essentially the same sounds (Appendix E). For example, the changes on /s/, /z/, /ʃ/, /tʃ/, /l/, /ð/, and /θ/ are quite evident in experimental groups of that project. These, in effect, are the same phonemes found to be significantly improved in the group of 60 subjects who received therapy four times weekly in the present project. Of interest, is the fact that the speech patterns of the 180 educable-retarded children who were enrolled in this project were quite similar in some regards to those of the children with normal abilities studied in the 1967 project. In particular, the phonemes cited as showing comparable improvements in treated groups in both studies constituted the greatest number of original articulation errors in both populations. However, the educable-retarded children demonstrated a much wider range of phonemic defectiveness and showed errors on some which are not commonly misarticulated in children having normal abilities and comparable chronological age or mental age levels, i.e., /d/, /t/, /f/, /g/, /k/, /n/, /b/, and /d$_z$/. Bangs (1942) reported a similar finding in a survey of articulation errors in an institutionalized population. In summary, the analysis of two independent experiments on articulation, both completed in schools in Montgomery County, Pennsylvania, and completed within a few years of each other, demonstrated that educable-retarded children appeared to make significant improvements in articulation of eight commonly misarticulated sounds, and that these sounds generally have been found to be those which show significant improvements as a result of group articulation therapy for children of normal ability drawn from primary grades within the public schools. The principal difference in the projects was that subjects in the 1967 study received one period of group articulation therapy weekly for 45 minutes and the 120 subjects received group articulation therapy in the present project for either one period per week of 30 minutes or for four 30-minute periods weekly.

The Secondary Dependent Variable, Error Scores on the Imitated Sentence Test

At the end of the experimental period (Post I) a sentence test was administered using a method of aural imitation to each of the 180 subjects in the project. This test was especially contrived, as noted previously, so that the auditory memory for sentences demands would be compatible with the abilities of retarded children for this task. As a result of field testing, it was determined that sentences had to be limited to five words. The sentences used were adapted in some cases from McDonald's Sentence Deep Test; however, many of the sentences were written especially for this project (the sentence test is included as Appendix F). The results of the Post I analysis of error scores based upon the sentence test indicated that no significant differences were obtained for Therapy. As expected, a significant Severity effect was obtained (and logically so since the original design was constituted on the basis of severity). The Stimulability variable was also significant, possibly suggesting that subjects having better initial stimulability scores were more capable of utilizing improved phonemes correctly in connected speech (although tenuous, this finding might be construed as some sort of a partial validation for the notion that stimulability has an important bearing in the utilization of phonemes correctly in connected speech). It should also be observed that the Carter/Buck Prognostic Test procedures actually may be akin to a type of sentence imitation except that syllables are used to solicit "change" responses. Therefore, this finding may not be totally unexpected. The lack of a significant Therapy effect was not in keeping with the significant Therapy effect for the picture articulation test. Although the interpretations of this finding are somewhat obscure, it seems not unlikely that subjects in the present study who have improved their articulation in some of the defective phonemes and certain phonetic context were yet incapable of translating these into connected speech. This type of articulation has been explained by Shelton (1967) as "acquisition" and considered basic in learning a new skill. Possible explanations for this finding might include:

(a) educable-retarded children may require a longer period of time to make the transition from improved articulation production across phonetic contexts (as elicited in a deep test);

(b) the carry-over techniques required to accomplish this transition need to be modified with such children in order to manifest improvements in connected speech, and

(c) changes in articulatory production, assessed on a picture articulation test, may not be valid indicators of the degree to which children may demonstrate changes on other speech tasks, such as imitating sentences or spontaneous utilization of corrected phonemes in connected speech.

In a study germane to the present issues involving interpretation, the author has recently completed a study of 131 school children from grades two through six who were found defective in only the /r/ phoneme. Subjects in this study were randomly dismissed from group articulation therapy on the basis of having achieved a level of articulatory proficiency assessed using single words elicited under speed. Subjects were tested three times over a period of fifteen months and compared with groups of children having the same /r/ proficiency levels but who remained in therapy. Not only were significant differences obtained in favor of the subjects who remained in therapy on an articulation test which measured the /r/ sound in words, but for the first time in the author's experience and to his knowledge, a significant Therapy effect from the pre- to the final post-testing (15 months later) was obtained on a carry-over, interview-type articulation test which used spontaneous speech as the criterion. Therefore, there was agreement that results obtained from articulation testing based on word stimuli related to those obtained from a measure of spontaneous speech. The degree to which these findings can be compared with the present study is unknown, since the /r/ defectives were children of normal ability.

Analyses of Both Dependent Variables at the Post II Time

The results of a Post I - Post II articulation assessment for all subjects on the picture articulation deep test agreed very well with the results on the Post II sentence test (which measured error scores, not difference scores). Subjects in experimental groups affected little or no change during the period following Post I. During this three months' interim none of the 180 subjects in this project received any speech therapy. Interestingly, all subjects demonstrated a high degree of constancy, and the Post I - Post II period was essentially a "static" one in terms of articulatory change. These results appeared rather surprising, since the impressions of many speech clinicians seem to be that children who gain proficiency in producing speech sounds in isolation, syllables, and words may often tend to show further improvements without additional therapy activities designed to enhance the so-called "carry-over" proposition. Educable-retarded subjects in the present project, however, remained almost immobile after the termination of therapy (the Post I period). Re-assessment at the Post II period merely substantiated the Post I finding that the four-times-a-week-group subjects were more improved and that subjects from all three groups retained their respective standings. In effect, neither the group of 60 subjects who received therapy one time a week or the 60 control group subjects managed to increase their scores substantially and "catch up" to the subjects who received therapy four times weekly during the treatment period.

One implication for this finding is that speech therapy with educable-retarded children, based upon procedures, methodologies, and principles similar to those of this project, probably should be maintained rather continuously in order to affect additional significant changes; since, once therapy was terminated, it appeared that subjects did not demonstrate additional improvements.

The Stimulability and Severity Variables

Research findings have rather consistently demonstrated that the initial severity of articulatory defectiveness is related to resultant changes, with or without the benefits of therapy (Sommers, 1967). Because of this knowledge, the Severity variable was studied as an independent one and randomized within the design of the present experiment. Additionally, a review by the author of the influence of the stimulability variable (Sommers, 1967) also indicated that this factor has been associated with articulatory changes in younger children. Again, level of stimulability performance was an independent variable and randomized throughout the three experimental groups. Surprisingly, these two factors appeared to have little bearing upon the outcome of articulation therapy for educable-retarded children. Based upon the results of the picture articulation testing, neither the stimulability or severity variables were found to have significant influences on the outcome of therapy, a finding contrary to one obtained by the author in the study of the effectiveness of therapy for kindergarten, first and second grade school children having misarticulations. The suggestion is that the articulatory problems of educable-retarded children are extremely resistant to influences of some speech variables.

A further suggestion is that it may take a substantial amount of intervention in the form of therapy time to achieve significant improvements. As case selection factors, total degree of articulatory defectiveness and stimulability performances may, therefore, have little consequence and possibly are not deserving of being applied (as they may be with articulatory defective children of normal intelligence) in making decisions about who is to receive therapy and who is not. Almost paradoxically, as noted previously, the phonemes which appeared to benefit from articulation therapy were almost identical in the two populations; yet, total severity and stimulability performance were not found related to it in the present experiment.

Comparisons with Wilson's 1966 Experiment

Relationship of Subject Variables and Articulation. One of the findings of Wilson's 1966 study on educable-retarded children in the special school district of St. Louis, Missouri, was that the severity of articulatory defectiveness was related to mental ages of the subjects, and that retarded children having mental ages of 3-0 to 5-5 were significantly more defective than those with advanced mental ages. In the present study, a slight relationship was observed, and subjects having lower mental ages tended to have greater numbers of articulatory errors. This finding would agree with that of Wilson and Bangs (1942). On the other hand, the present study determined that subjects having lower IQ's tended to have greater number of articulatory errors, and this is a finding which Wilson's study does not support. It should be mentioned that reported relationships between severity of articulatory defectiveness and each of the variables of mental age and IQ were statistically significant in the present study but of slight importance.

Main Findings. In contrast to Wilson's (1966) study, the present one was in agreement with one reported by Schlanger (1953) since it determined that educable-retarded children made significant improvements in articulation during the course of the school year as measured on a picture articulation test. As described earlier (pp.5-6), there were many similarities in the population of the two studies. Yet, there were many differences in these two studies. Chief among these was the fact that Wilson's subjects received only two periods of articulation therapy weekly; whereas, those subjects demonstrating significant improvements in the present project received four 30-minute periods weekly. Many other differences might have accounted for the discrepancies in findings between the two projects including:

(a) measurement devices used,

(b) testing reliability,

(c) numbers of raters,

(d) nature of the speech therapists who applied the therapy, and

(e) methods of data analysis.

Other Differences. As presented in Table 1, the mean chronological age for subjects in this study was 8 years and 8 months; the mean mental age was 6 years and 1 month; the mean IQ was 70. The range for each of these variables was: 3 years and 10 months to 8 years and 2 months for mental ages; 5 years and 9 months to 12 years and 2 months for chronological ages; and 49 to 80 for the IQ's. Wilson's average subject in his project appeared to be older chronologically and with slightly higher mental ages and very similar IQ's. For example, he reported that his average subject had a chronological age of 9 years and 10 months, a mental age of 6 years and 6 months, and an IQ of 67. A study of the distribution of Wilson's subjects also revealed that his population contained a higher percentage of both younger and older subjects and was, therefore, less homogenous in regard to these variables. In the main, however, the populations of the two studies were remarkably similar and, as noted earlier in this document, drawn from very comparable populations socioeconomically and educationally.

Placebo Group. Wilson utilized a placebo group of 135 subjects. At the end of the project, three years later, only 65 such subjects remained and could be utilized in the assessment of articulatory change. The placebo group subjects received two half-hour sessions per week of speech and language stimulation but, according to Wilson, did not receive therapy aimed at correcting individual articulation errors. In view of the fact that Wilson's placebo group did not achieve any significant improvements over the three year period, and in effect, improved to the same degree as his control group, the present study did not utilize a placebo group. Therefore, a greater percentage of subjects in the present study were included in the therapy groups compared with Wilson's project, and the present study used only a single control group.

Attrition. The attrition in Wilson's three year project appeared to be much greater than that in the present one. For example, at the beginning of Wilson's study there were 140 subjects in the experimental group, 145 children in the control group, and 130 children in the placebo group. At the end of his study, he recorded that there were 115 children remaining in the experimental group, 107 in the control group, and 65 in the placebo group. In the present study, only three subjects were lost during the experimental period, and no subjects were lost from the Post I to the Post II period (due to special efforts of raters to locate and test subjects who had moved).

Data Analysis. Wilson's data were analyzed using a three-part analysis of variance which included an analysis of the therapy, IQ, and severity. His design, however, was a simple randomized one in which subjects were merely randomly assigned to either therapy, control group or to the placebo group. At the end of his study, his cell size was reduced to 12, and an analysis of his main findings and interactions are based on a total of 132 subjects. The present project also had 12 cells of 15 subjects each, and the analyses of the main factors and interactions were based on a total of 180 subjects. Sample size, therefore, was quite similar between the two projects. A principle difference was the fact that the present study used a factorial design in which the variables of severity, stimulability and therapy were randomly entered into the experiment and analyzed accordingly.

Group and Individual Therapy. Another difference between the two studies has to do with group and individual therapy. According to Wilson, a number of his subjects received individual or group therapy from time to time based upon their needs during the course of the three years. He reported that at no time did a group exceed four in number for the experimental subjects. This is the same number of subjects that were entered into group articulation classes in the present project, although no subjects in this project received any individual therapy at any time.

Dependent Variables. The present project extended over a period of 15 months and included two independent measurements on two different dependent variables. Wilson's project extended over a period of three years with annual post recordings made at the end of each year on the picture articulation test. His results were tape recorded and judged at the end of the experiment for all subjects in a randomized fashion. In Wilson's project, only one rater served to evaluate the articulation errors of the subjects. In the present project, seven raters tested on a Pre-, Post I- and Post II- basis and in contrast to Wilson's use of error scores, this project looked heavily at difference scores on its primary dependent variable, namely, picture articulation deep test scores. Wilson utilized the Henja Articulation Picture Test as his dependent variable. The present study used a different methodology in assessing articulation, a "deep test" which measured articulation across 29 phonetic contexts per phoneme, yet also utilized pictures as stimuli. Regardless of many important differences between the two types of measurements, is the fact that both judgments of speech change were based upon the eliciting of speech through unitary responses rather than through measurements of spontaneous speech, measurements of change through reading, and so forth. However, in the present study, a secondary dependent variable consisted of the eliciting of articulation production through an imitated deep sentence test. This is a different measurement from that used by Wilson.

Therapy. The therapy described by Wilson would appear to be quite similar to that used in the present project. Both studies employed methods of rather traditional articulation therapy involving development of correct production of phonemes in isolation, nonsense syllables, words and spontaneous speech. The methods designated by Wilson for use with his subjects were similar in that they were based upon the method of phonetic placement, method of approximations, and the utilization of apparatus such as tape recorders and mirrors. These are essentially the same types of procedures and equipment used in the present project.

RECOMMENDATIONS

The findings of the present project, although encouraging in the sense that they suggested that certain articulation skills of educable-retarded children could be improved significantly, left a number of unanswered questions concerning the ultimate outcome of such endeavors. For example, the problem of carry-over, long recognized by speech therapists and others as one of the more challenging ones in the therapy process (Sommers, 1969) appeared to be a formidable one for retarded subjects. The techniques used to facilitate the carry-over process in the present study were highly similar to those commonly used to accomplish this with children of normal ability. It is suggested that future research concerning the efficacy of articulation therapy for such children attempt to utilize a series of different types of carry-over activities at important junctures in the therapy process. The introduction of interested parents at an appropriate point in therapy might prove effective in arriving at the specified goal of getting correct production of phonemes into connected speech; yet experience tends to suggest that parents of many retarded children are less willing to become involved. It is also conceivable that the period of the present study was too brief to allow retarded children to make the transition from stimuli presented as they are in a deep test of articulation to imitated sentences. The duration may have been adequate to demonstrate what Shelton (1967) called "acquisition", i.e., correct production of a phoneme in single utterances such as a syllable or a word, but not "automatization", i.e., establishment of correct articulatory responses in all speech regardless of conditions. It is conceivable that future therapy endeavors and assessments should be cognizant of the fact that more of an experimental period is necessary, more effort is needed, and more innovation is possibly going to be required in order to advance such children satisfactorily on a path leading to normal spontaneous speech.

Articulation research with educable-retarded children should be aware of the fact that the two variables found almost uniformally to relate to improvements, with or without therapy, in articulatory defective children of normal intelligence, namely, stimulability and severity of articulation defectiveness, were not related to improvements made by subjects in this project. This rather surprising finding suggests the possibility that the articulation problems of educable-retarded children are unique, somewhat intractable, and resistant to change without therapy. Therefore, future research might well give attention to other unexplored variables such as differences in oral-stereognostic skills, auditory perceptual functioning, motivations for improved speech, language usage, and other unexplored factors.

Finally, results of the present project suggest that once speech therapy has been discontinued, retarded children do not improve their articulation in any significant way without the benefit of correctional service. This may well mean that the therapy process for educable-retarded children should be a continuous, ongoing effort, frequently re-assessed with special provisions made for facilitating the carry-over of improved or corrected phonemes to levels of connected speech, most important of which is spontaneous speech.

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APPENDIX A

SPEECH EVALUATION FORM

MONTGOMERY COUNTY PUBLIC SCHOOLS
INITIAL RECORD FORM

DISTRICT OF RESIDENCE ____________________

Name ____________________ Date ____________

School ____________________ Age ____ Birthdate ____________

Teacher ____________________ Grade ____________

Parent ____________________ Phone ____________

Address ____________________

PRE PHONETIC ANALYSIS

I.

	k	g	f	v	θ	s	z	S	tS	l	r	ɝ	ɚ		
I															
M															
F															

II.

	t	d	p	m	n	h	w	ŋ	dʒ	ð	ʒ	b			
I															
M															
F															

III.

	i	I	ɛ	ae	ʌ	a	ɔ	ʊ	u	ju	ou	au	eI	aI	ɔI
I															
M															
F															

Isolation

IV.

Intelligibility: ____________________
Rhythm Patterns: ____________________
Voice Anomalies: ____________________
Oral Peripheral: ____________________
Hearing: ____________________

Psychological: ____________________

Comments: ____________________

SPEECH EVALUATION FORM

POST PHONETIC ANALYSIS

I.

	k	g	f	v	θ	s	z	S	tS	l	r	ʒ·	ɤ'		
I															
M															
F															

II.

	t	d	p	b	m	n	h	w	ŋ	dʒ	ð	ʒ			
I															
M															
F															

III.

	i	I	ɛ	ae	ʌ	a	)	U	u	ju	ou	aʊ	eI	aI	)I
I															
M															
F															

Comments: ____________________

____

____

APPENDIX B

PROGNOSTIC TEST FOR CASE SELECTION

SPONTANEOUS TEST - TABLE 1

	INITIAL				MEDIAL				FINAL			
		Sub	Dis	Omm		Sub	Dis	Omm		Sub	Dis	Omm
(S)	Santa				Ice Cream				House			
	Saw				Bicycle				Horse			
	Soap				Gas station				Bus			
(Z)	Zipper				Scissors				Nose			
	Zebra				Freezer				Balls			
	Zoo				Razor				Bubbles			
(L)	Ladder				Balloon				Bell			
	Leaf				Telephone				Ball			
	Letter				Calendar				Table			
(F)	Fire				Waffle				Knife			
	Feet				Elephant				Calf			
	Fan				Coffee				Safe			
(V)	Vest				Envelope				Stove			
	Vacuum				Shovel				Glove			
	Vase				Television				Five			
(K)	Key				Monkey				Sink			
	Corn				Cookies				Tank			
	Candle				Chicken				Snake			
(G)	Gum				Buggy				Dog			
	Gate				Wagon				Pig			
	Goat				Tiger				Frog			
(R)	Rake				Arrow				Car			
	Rabbit				Carrot				Star			
	Radio				Merry-go-round				Deer			
(ʃ)	Shoe				Dishes				Fish			
	Shirt				Washer				Brush			
	Shovel				Flash light				Bush			
(tʃ)	Church				Matches				Bench			
	Chimney				Hatchet				Watch			
	Chair				Teacher				Witch			
(dʒ)	Jet				Pajamas				Bridge			
	Giraffe				Fire engine				Birdcage			
	Jacks				Soldier				Badge			
(θ)	Thumb				Bathtub				Wreath			
	Thimble				Toothpaste				Teeth			
	Thermometer				Toothbrush				Mouth			
(ð)					Father							
					Mother							
					Brother							

PROGNOSTIC TEST FOR CASE SELECTION

NONSENSE SYLLABLE TEST - TABLE 2

	INITIAL				MEDIAL				FINAL			
		Sub	Dis	Omm		Sub	Dis	Omm		Sub	Dis	Omm
(s)	si				isi				is			
	sæ				æsæ				æs			
	sa				asa				as			
(z)	zi				izi				iz			
	zæ				æzæ				æz			
	za				aza				az			
(l)	li				ili				il			
	læ				ælæ				æl			
	la				ala				al			
(f)	fi				ifi				if			
	fæ				æfæ				æf			
	fa				afa				af			
(v)	vi				ivi				iv			
	væ				ævæ				æv			
	va				ava				av			
(k)	ki				iki				ik			
	kæ				ækæ				æk			
	ka				aka				ak			
(g)	gi				igi				ig			
	gæ				ægæ				æg			
	ga				aga				ag			
(r)	ri				iri				ir			
	ræ				æræ				ær			
	ra				ara				ar			
(ʃ)	ʃi				iʃi				iʃ			
	ʃae				æʃæ				æʃ			
	ʃa				aʃa				aʃ			
(tʃ)	tʃi				i tʃ i				i tʃ			
	tʃæ				æ tʃæ				ætʃ			
	tʃ a				a tʃ a				a tʃ			
(dʒ)	dʒ i				i dʒ i				i dʒ			
	dʒæ				æ dʒæ				æ dʒ			
	dʒ a				a dʒ a				a dʒ			
(θ)	θi				i θ i				i θ			
	θæ				æθæ				æθ			
	θa				a θ a				a θ			
(ð)	ð i				i ð i				i ð			
	ðæ				æ ð æ				æ ð			
	ð a				a ð a				a ð			

Appendix C. Research version of McDonald's deep test of articulation measuring 21 phonemes

Examiner______________

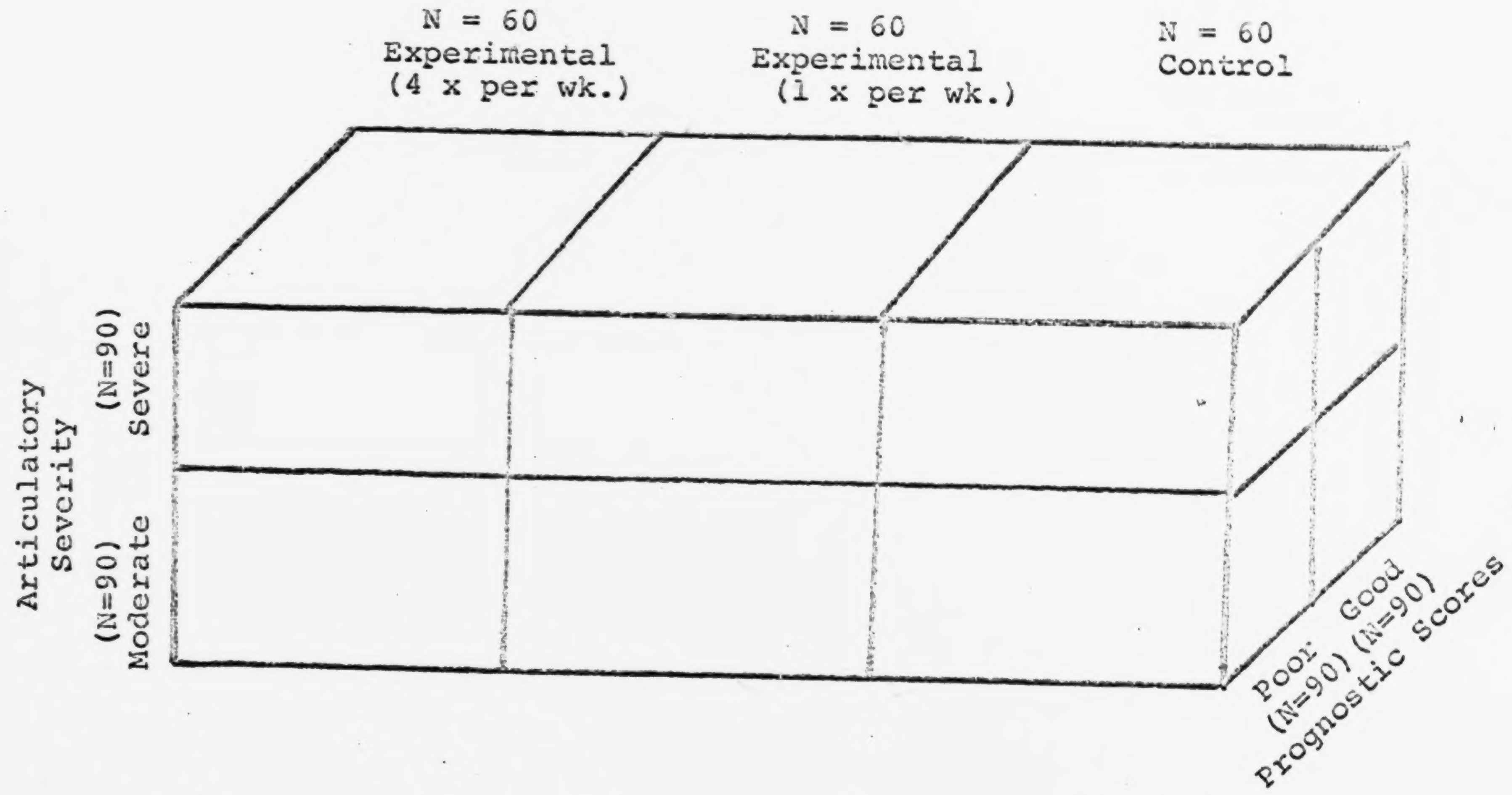
Name________________________ Date__________________

/k/	/g/	/f/	/t/	/d/	/v/	/ŋ/	/θ/	/m/	/n/	/l/	/dʒ/	/j/
__k__	__k__	__k__	__k__	__k__	__k__	__k__	__k__	__k__	__k__	__k__	__k__	__k__
__g__	__g__	__g__	__g__	__g__	__g__	__g__	__g__	__g__	__g__	__g__	__g__	__g__
__f__	__f__	__f__	__f__	__f__	__f__	__f__	__f__	__f__	__f__	__f__	__f__	__f__
__v__	__v__	__v__	__v__	__v__	__v__	__v__	__v__	__v__	__v__	__v__	__v__	__v__
__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__
__l__	__l__	__l__	__l__	__l__	__l__	__l__	__l__	__l__	__l__	__l__	__l__	__l__
__s__	__s__	__s__	__s__	__s__	__s__	__s__	__s__	__s__	__s__	__s__	__s__	__s__
__z__	__z__	__z__	__z__	__z__	__z__	__z__	__z__	__z__	__z__	__z__	__z__	__z__
__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__
__tʃ	__tʃ	__tʃ	__tʃ	__tʃ	__tʃ	__tʃ	__tʃ	__tʃ	__tʃ	__tʃ	__tʃ	__tʃ
__r__	__r__	__r__	__r__	__r__	__r__	__r__	__r__	__r__	__r__	__r__	__r__	__r__
__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__	__ɝ__
__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__
__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__	__ɪ__
__ae__	__ae__	__ae__	__ae__	ae__	__ae__	__ae__	ae__	__ae__	__ae__	__ae__	__ae__	__ae__
__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__	__ɔ__

McDonald's deep test of articulation (cont'd):

/s/	/ð/	/z/	/ʃ/	/tʃ/	/r/	/ʒ/	/ð/
__k__	__k__	__k__	__k__	__k__	__k__	__k__	__k__
__g__	__g__	__g__	__g__	__g__	__g__	__g__	__g__
__f__	__f__	__f__	__f__	__f__	__f__	__f__	__f__
__v__	__v__	__v__	__v__	__v__	__v__	__v__	__v__
__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__	__θ__
__l__	__l__	__l__	__l__	__l__	__l__	__l__	__l__
__s__	__s__	__s__	__s__	__s__	__s__	__s__	__s__
__z__	__z__	__z__	__z__	__z__	__z__	__z__	__z__
__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__	__ʃ__
__tʃ__	__tʃ__	__tʃ__	__tʃ__	__tʃ__	__tʃ__	__tʃ__	__tʃ__
__r__	__r__	__r__	__r__	__r__	__r__	__r__	__r__
__ʒ__	__ʒ__	__ʒ__	__ʒ__	__ʒ__	__ʒ__	__ʒ__	__ʒ__
__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__	__ð__
__I__	__I__	__I__	__I__	__I__	__I__	__I__	__I__
__ae__	__ae__	__ae__	__ae__	__ae__	__ae__	__ae__	__ae__
__)__	__)__	__)__	__)__	__)__	__)__	__)__	__)__

Appendix D. Three-dimensional view of the research design.



Appendix E. Articulation pre, post, and improvement scores by sound for subjects in the experimental and control groups in the 1967 study on "Factors Related to the Effectiveness of Articulation Therapy for Kindergarten, First, and Second Grade Children."

Sound	Experimental Subject Scores			Control Subject Scores		
	Pre-	Post-	Difference	Pre-	Post-	Difference
/s/	2127	954	1173	2064	1724	340
/z/	2062	904	1158	2011	1711	300
/ʃ/	927	462	465	608	462	146
/tʃ/	640	324	316	610	376	234
/l/	329	216	113	303	211	92
/θ/	1063	556	507	1257	912	345
/ʒ/	1075	583	492	1286	991	295
/ð/	565	380	185	718	537	181
/r/	690	503	187	966	748	218
/f/	49	29	20	100	86	14
/k/	46	0	46	63	3	60
/g/	70	22	48	75	13	62
TOTALS			4710			2287

Appendix F. Modified version of McDonald's deep sentence test.

Name of Subject:______________________________Grade:_____

School:______________________________Raters Name:__________

/P/

1. See the dog's paw.
2. Look at this pen.
3. This is a sweet pickle.
4. Eat the good pie.
5. Tom and I like Pete.

1. The soap tastes bad.
2. See the top spin.
3. Eat the soup now.
4. Shoot the cap gun.
5. Please mop the floor.

/B/

1. Bill and I love baseball.
2. I see the football.
3. Look at his bed.
4. Please don't push Bill.
5. Wear a big belt.

1. Fill the tub now.
2. Don't grab the stick.
3. Rub John's right hand.
4. Scrub the kitchen floor.
5. A crab can bite.

/N/

1. I saw ten kings.
2. Put the red can there.
3. He is a fine boy.
4. It is a tin chair.
5. He can run fast.

1. The dog's nose is cold.
2. Take the bus now.
3. See the fish net.
4. The dog nips hard.
5. I have five nails.

/ŋ/

1. Take a long nap.
2. Are you fishing there?
3. Is the king dead?
4. Do you play ping pong?
5. Let us sing songs now.

1. Put ink in the pen.
2. The man is English.
3. The count is in England.
4. Give me some ink.
5. That is nice ink.

/T/

1. Take time for play.
2. I can talk to you.
3. Pick up ten pennies.
4. I like push toys.
5. Hear the watch tick.

1. Did the cat bite?
2. Should we eat first?
3. Dot the small I.
4. See the boat go.
5. What can you do?

/D/

1. I saw a big duck.
2. The black dog ran away.
3. Where did you go?
4. Come down the hill.
5. Please do the work.

1. He had seven toys.
2. I am a good boy.
3. He did go home.
4. He could show it to me.
5. I have a red kite.

/K/

1. He had candy for you.
2. Our bus came late today.
3. Which cup do you want?
4. I will come to your house.
5. Our dog can run fast.

1. I like pie for supper.
2. They had a black dog.
3. He took food to the pig.
4. May I take this one?
5. I have a black shoe.

/G/

1. Do fish go to sleep?
2. I can go with you.
3. His game is funny.
4. Jane gave him a cat.
5. I eat good candy.

1. He had a big nose.
2. We saw a tugboat.
3. The pig likes corn.
4. Does your dog bark at people?
5. Our dog saw a rabbit.

/F/

1. A man came for it.
2. Does father have a ball?
3. Get a dish for the cake.
4. Did the man find it?
5. I hope father can play.

1. Don't laugh too much.
2. Ask her if those are mine.
3. Is it a safe road?
4. Ask mother if she may go.
5. Our city has a safe zoo.

/V/

1. I like vegetable soup.
2. He will come very soon.
3. She has a nice voice.
4. She can sing very well.
5. He has a deep voice.

1. We live by a road.
2. We have candy for our party.
3. Will you move far away?
4. We will leave soon.
5. I live down by the lake.

/θ/

1. I like thick soup.
2. I can think about it.
3. Which thing do you mean?
4. Don't rub thin paint.
5. Make the face thin.

1. I want both boys to come.
2. His teeth can bite.
3. My tooth felt good.
4. Make your mouth sad.
5. You may both jump at once.

/ð/

1. Rub that on your leg.
2. Did you dig that hole?
3. May I push this car?
4. May I have that one?
5. We ate all their cake.

1. I will bathe Jim.
2. He can breathe now.
3. I will clothe Mary.
4. Mary can breathe better.
5. Clothe Tina's doll now.

/S/

1. I made some cakes.
2. I can see you.
3. A dog sat by the door.
4. Which seat is mine?
5. The pup sat down.

1. I ride the bus to school.
2. This game is fun.
3. This shoe is red.
4. The nice lady had a dog.
5. Ice pick is sharp.

/Z/

1. I saw a fat zoo animal.
2. This is the safe zone.
3. We saw a huge zebra.
4. Our zoo has a monkey.
5. Which zoo is this.

1. It is time to go.
2. The night was dark.
3. It is fun to play ball.
4. Please keep off the grass.
5. He has many shoes.

Appendix F (cont'd):

/ʃ/

1. That ship will sail soon.
2. We saw a good show.
3. I have shut the door.
4. I guess she did it.
5. Keep your mouth shut.

1. Which dish did you break?
2. I must wash my face.
3. Get a dish for me.
4. The fish saw the boat.
5. I saw a fish jump.

/tʃ/

1. That chair is for mother.
2. Five children may go.
3. I wish children could fly.
4. This child may go.
5. Her child may take one.

1. Which car shall we take?
2. Which game shall we play?
3. I like to catch fish.
4. May I touch somebody?
5. Watch them run to school.

/L/

1. He can hop like a rabbit.
2. I ate a hot lunch.
3. I can walk like a duck.
4. I have long hair.
5. He was late today.

1. A tall boy came to school.
2. They can stay all day.
3. We saw a real cow.
4. Catch the ball for me.
5. Roll the ball to me.

/R/

1. Bob read a book.
2. I like red apples.
3. He can run fast.
4. I have red shoes.
5. Which rope is mine?

1. Let the car pass.
2. Make a cake for me.
3. Their zoo is big.
4. Your leg is cut.
5. I saw a car there.

/ɝ/

1. I woke up early.
2. See the big earth.
3. I can earn money.
4. I know Wyatt Earp.
5. I took Earl yesterday.

1. Mommy has a fur coat.
2. Please stir the soup.
3. I gave her more money.
4. Purr said the kitten.
5. Burr shot the eskimo.

/ɚ/

1. The boy ran after the ball.
2. Mother cooked the food.
3. I mailed a letter today.
4. The spider scared me.
5. I am better today.

/dʒ/

1. This is good jam.
2. That is a big joke.
3. The bus just left.
4. His jump was high.
5. Her joke was funny.

1. What is your age today?
2. Is that page done?
3. The man had huge feet.
4. The first page burned.
5. The cage came down.

BUREAU OF EDUCATION FOR THE HANDICAPPED
DIVISION OF RESEARCH

PROJECT NO: 7-0342 (Final Report)

TITLE: Factors in the Effectiveness of Articulation Therapy with Educable Retarded Children

AUTHOR: Ronald K. Sommers

INSTITUTION: Montgomery County Schools
Norristown, Pennsylvania

RECOMMENDATION: Approval and submission to ERIC

SUMMARY OF REVIEWS

This report has been reviewed by consultants and staff. On the basis of this review we are recommending approval of the report and submission to ERIC.

Consistency with Proposal

No major changes from the proposal were noted in the report. Population, sampling procedures, design, and data analysis were virtually identical with those proposed. With regard to criterion measures, there was no evidence that the Stanford-Binet was administered to the subjects--the authors did not state on which test the IQs were based. Specific details on the experimental program were lacking; however, it did not appear to deviate from the proposed program.

Technical Soundness

The project, as proposed and implemented, was technically sound. The population, sampling procedures, design, and data analysis were quite appropriate to the activity. Reviewers found the procedures consistent with sound professional practice.

Adequacy of Reporting

The rationale was well presented and the description of the program was clear and, with minor exceptions, complete. The experimental program was not described in detail. The data were presented and thoroughly discussed. For a speech pathologist or speech therapist the report would be significant; due to the terminology, a teacher would probably not find this report particularly useful.

Educational Significance

The problem area was well presented and the project was related to the problem area. The discussion maximizes the educational significance with respect to future research. This report tends to indicate that more research is needed in this area, but that speech therapy for EMR children should be a continuous ongoing effort.

Technical Quality of Report

This report did not deviate from the OE format--with pagination being the only exception. Reproduction was poor. Spelling, grammar, and organization were excellent. The report was carefully edited. With one exception, Table 8, tables and presentation of data were clear.